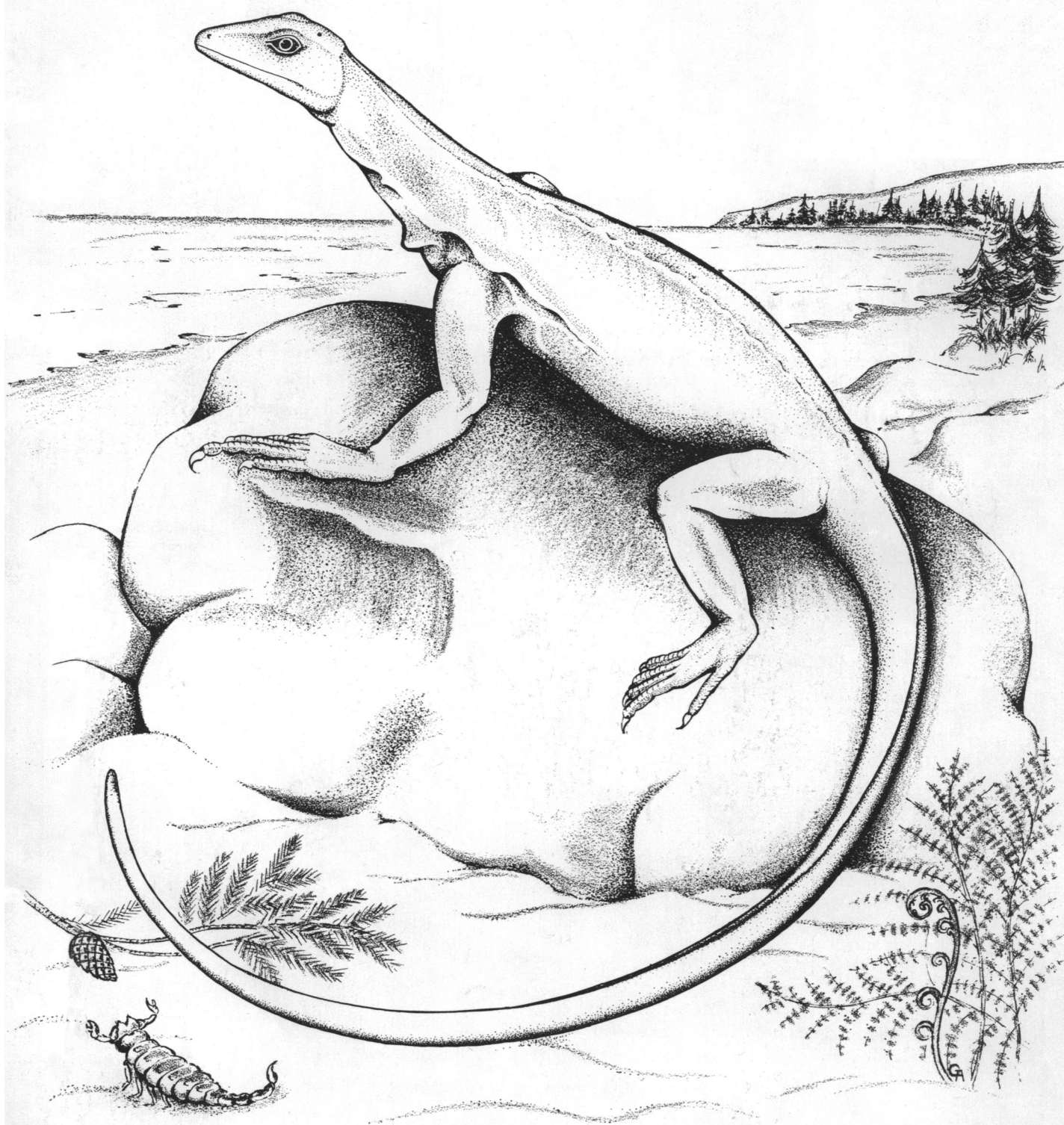


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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

3 June 1977, Volume 196, No. 4294



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Volume 196, No. 4294

# SCIENCE

<b>LETTERS</b>	Holography and Image Display in X-ray Crystallography: <i>G. W. Stroke</i> et al.; Soil Conservation: <i>H. E. Conklin</i> ; Btu Borrowing?: <i>S. F. Singer</i> ; "Kerfuffle": <i>F. M. McMillan</i> . . . . .	1040
<b>EDITORIAL</b>	The Blind Side of Science Policy . . . . .	1045
<b>ARTICLES</b>	The Boranes and Their Relatives: <i>W. N. Lipscomb</i> . . . . . A Response Regulator Model in a Simple Sensory System: <i>D. E. Koshland, Jr.</i> . . . .	1047 1055
<b>NEWS AND COMMENT</b>	Soviet-U.S. Science Agreements: Press Presides over Reappraisal . . . . . <i>Science in Europe</i> /Carter Nuclear Policy Finds Few Friends . . . . . Alaskan Gas: NEPA Brings Out a Strong New Pipeline Applicant . . . . . Contract Archeology: New Source of Support Brings New Problems . . . . .	1064 1067 1068 1070
<b>RESEARCH NEWS</b>	Blood Clotting: The Role of Prostaglandins . . . . . Drinkers Rejoice: A Little Wine May Kill Your Virus . . . . . The AMIS Trial: Can Aspirin Prevent Heart Attacks? . . . . .	1072 1074 1075
<b>AAAS NEWS</b>	Second R & D Colloquium to Be Held 15-16 June; NSF Chautauqua-Type Short Courses; Scientific Manpower Commission Surveys AAAS Affiliates; Spanish AAS Meets in León; Science Film Festival Expanded for 1978 Annual Meeting; For the Library; AAAS Annual Elections: Preliminary Announcement	1076
<b>BOOK REVIEWS</b>	Mathematical Bioeconomics, reviewed by <i>G. R. Conway</i> ; Syntony and Spark, <i>R. Belfield</i> ; CO <sub>2</sub> Metabolism and Plant Productivity, <i>G. H. Heichel</i> ; Optics of the Atmosphere, <i>J. N. Howard</i> ; Books Received . . . . .	1082
<b>REPORTS</b>	Retention of Plutonium and Americium by Rock: <i>S. Fried</i> et al. . . . .	1087

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# AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Mars: Microwave Detection of Carbon Monoxide: <i>R. K. Kakar, J. W. Walters, W. J. Wilson</i> . . . . .	1090
<i>Petrolacosaurus</i> , the Oldest Known Diapsid Reptile: <i>R. R. Reisz</i> . . . . .	1091
Intermetallic Compounds of the Type $MNi_3$ as Methanation Catalysts: <i>A. Elattar et al.</i> . . . . .	1093
Mercury Emissions from Geothermal Power Plants: <i>D. E. Robertson et al.</i> . . . . .	1094
Stable Semiconductor Liquid Junction Cell with 9 Percent Solar-to Electrical Conversion Efficiency: <i>K. C. Chang et al.</i> . . . . .	1097
Clear Air Turbulence: Detection by Infrared Observations of Water Vapor: <i>P. Kuhn, F. Caracena, C. M. Gillespie, Jr.</i> . . . . .	1099
Asymmetric Structure of the Purple Membrane: <i>A. E. Blaurock and G. I. King</i> . . . . .	1101
The Earth as a Seismic Absorption Band: <i>D. L. Anderson et al.</i> . . . . .	1104
Nuclear Morphometry During the Cell Cycle: <i>F. Kendall et al.</i> . . . . .	1106
Direct Resorption of Bone by Human Monocytes: <i>G. R. Mundy et al.</i> . . . . .	1109
Apical Dichotomy Demonstrated in the Angiosperm <i>Flagellaria</i> : <i>P. B. Tomlinson and U. Posluszny</i> . . . . .	1111
Growth Hormone: Species-Specific Stimulation of Erythropoiesis in vitro: <i>D. W. Golde, N. Bersch, C. H. Li</i> . . . . .	1112
Genetic Rescue of a Lethal "Null" Activity Allele of 6-Phosphogluconate Dehydrogenase in <i>Drosophila melanogaster</i> : <i>M. B. Hughes and J. C. Lucchesi</i> . . . . .	1114
Serum Complement-Like Opsonic Activities in Human, Animal, Vegetable, and Proprietary Milks: <i>M. E. Miller and R. G. Ganges</i> . . . . .	1115
Cleptoparasitism and Odor Mimetism in Bees: Do <i>Nomada</i> Males Imitate the Odor of <i>Andrena</i> Females?: <i>J. Tengö and G. Bergström</i> . . . . .	1117
Hypoxanthine Phosphoribosyltransferase: Two-Dimensional Gels from Normal and Lesch-Nyhan Hemolyzates: <i>G. S. Ghangas and G. Milman</i> . . . . .	1119
Erythema Chronicum Migrans and Lyme Arthritis: Cryoimmunoglobulins and Clinical Activity of Skin and Joints: <i>A. C. Steere, J. A. Hardin, S. E. Malawista</i> . . . . .	1121
Licking Behavior: Evidence of Hypoglossal Oscillator: <i>Z. Wiesenfeld, B. P. Halpern, D. N. Tapper</i> . . . . .	1122
Classical Nictitating Membrane Conditioning in the Awake, Normal, Restrained Cat: <i>M. M. Patterson, J. Olah, J. Clement</i> . . . . .	1124
Technical Comments: Measuring Plutonium Concentrations in Respirable Dust: <i>J. A. Hayden, C. J. Johnson, R. R. Tidball, R. C. Severson</i> . . . . .	1126

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## COVER

Reconstruction of the fossil reptile, *Petrolacosaurus*. Accidental deaths in or near a river resulted in rafting of numerous carcasses of reptiles to a quiet marine embayment. Thus, the brackish water Rock Lake deposits near Garnett, Kansas, supply a unique picture to an important chapter in the history of reptiles. See page 1091. [Drawn by Mrs. G. Anderson]

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## LETTERS

### Holography and Image Display in X-ray Crystallography

One cannot but agree with Carroll K. Johnson (Letters, 29 Apr., p. 478) concerning the need for crystallographers to continue working on improving solutions to the "phase problem," as required in x-ray crystallography. It is likely, moreover, that holography (1, 2) may make a contribution to this problem as well (2-4).

Our efforts at this time, however, are directed at another equally important problem in crystallography, namely, that of *displaying* the reconstructed structures, once computed, in three dimensions (5-7). Holography (1, 2), with its well-known three-dimensional display capabilities in many domains of science from electron microscopy to ultrasonic imaging (8), has now been proved through this work (5-7) to have a most promising potential also in crystallography and one which is widely considered by many crystallographers to be worthy of further investigation (7). A very effective approach, we find, is the use of opto-digital (holographic) computing (6, 7, 9), for which we have developed a new type of digital hologram (7). Holographic computing combines the most effective steps in digital and optical computing, respectively, through reconstruction of images in sections of the structure. It is now also possible to obtain images of the structure of the entire molecule in three dimensions, with atoms appearing as diffuse sources, through superposition holography (2) by a two-dimensional optical Fourier transformation from digitally computed "Fourier-domain projection holograms" (7, 8). This technique shows promise of solving the "feature extraction" pattern-recognition problems that have long plagued crystallographers, who heretofore had available only electron-density maps (rather than images) of such sections.

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10. Supported by NSF grant MCS-76-11010. G.W.S. acknowledges the many kind and fruitful suggestions from J. R. Pasta and J. B. Kinsinger, as well as from C. N. Yang.

### Soil Conservation

I read with interest Luther J. Carter's article "Soil erosion: The problem persists despite billions spent on it" (News and Comment, 22 Apr., p. 409). However, he fails to mention an opportunity for correcting the situation at low cost.

Since a decline in a national food supply normally raises prices more than proportionately (barring burdensome surpluses), and since the elimination of water pollution caused by soil erosion would mean at least some shifts from high-yielding, intertilled crops to lower-yielding small grains, grasses, and forests, a truly effective soil conservation program would increase farm receipts while reducing farm expenses. If this fact could be convincingly conveyed to farmers, they might agree that it is not even to their short-term advantage, collectively, to oppose such a program.

To convey this idea would require a significant turnabout by the educational agencies that normally reach farmers. These agencies, to gain the rapid acceptance of new technology that reduces the cost of food, have stressed to farmers the importance of increasing productivity as a means of ensuring individual survival in the competitive struggle. In doing this they have imparted to farmers a knee-jerk opposition to anything that reduces production or that increases costs.

It has been my experience that farmers are at first suspicious but may soon begin to start thinking about the possibility that they might benefit even from an action as extreme as outlawing the manufacture and use of fertilizer. I am confident that a concerted educational effort could gain their acceptance of strong conservation measures if they knew that they were to be applied nationwide and backed up by embargos on foods produced with exploitive techniques elsewhere in the world, and if assurances were given that

an agency would be formed to equalize the resulting benefits among all farmers.

A soil conservation program supported by farmers would be much more effective and less costly in tax dollars than one imposed on them by a police force.

HOWARD E. CONKLIN

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## Btu Borrowing?

I have a modest proposal which might settle the controversy about energy analysis and the "net energy" concept involving Malcolm Slessor, Howard T. Odum, and David Huettnier (Letters, 11 Apr., p. 259). Instead of paying for imported oil in dollars, let us borrow Btu's from Saudi Arabia and pay them back in Btu's some years from now, after fusion power or some other essentially inexhaustible source of energy has been developed—with interest of course. If they accept this proposal, then we can consider the controversy settled in favor of net energy accounting.

S. FRED SINGER

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## "Kerfuffle"

Is Nicholas Wade, who writes so succinctly about techniques of gene splicing with recombinant DNA molecules (25 Feb., p. 762), practicing analogous techniques of syllable splicing and recombinant "verbarianism" when he speaks of a regulatory "kerfuffle"?

Presumably a kerfuffle is something like the brouhaha which he mentions earlier, but I could not find the word in any regular or slang dictionary. F. B. Hilmer (personal communication) suggests that Wade has grafted the prefix "ker-" to "fuffle" (to put, or be, in disorder), as in kerplop, kersplash, and so forth. But we doubt that he has a valid hybrid because (i) it is not onomatopoeic, and (ii) it is used as a noun, whereas the precedents are usually adverbs.

Perhaps we also need guidelines for this kind of recombinant research, else we shall soon encounter such hybrids as "broufuffle" and "kerhaha."

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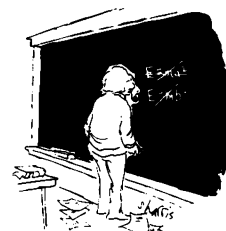
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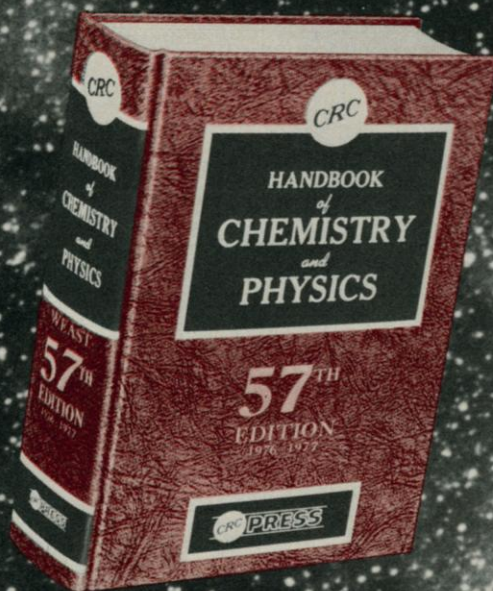
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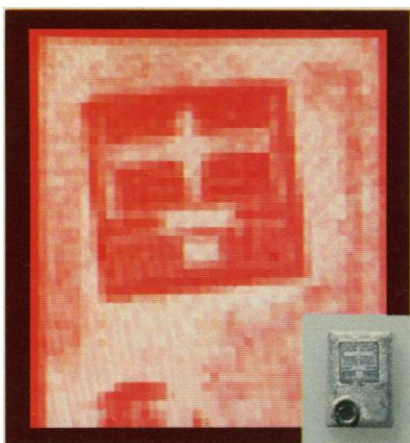
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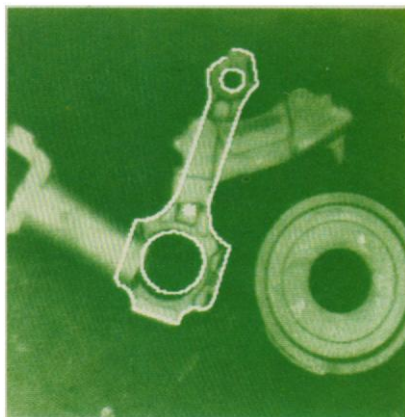
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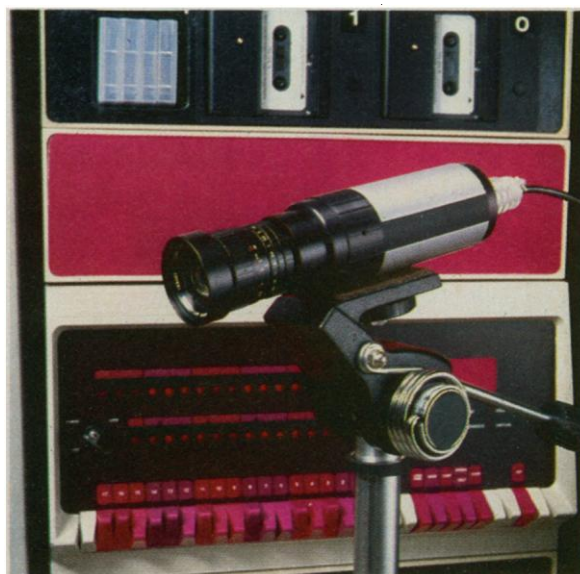


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## The Blind Side of Science Policy

In the on-again, off-again chronology of the President's Office of Science and Technology Policy there has been at least one consistency: it never has had a voice in the economic policy circles of a President. Unlike other advanced nations, both democratic and authoritarian, the United States has not seen fit to make explicit the role of science and technology in mapping economic strategy. We are likely to regret it.

In last year's presidential race, both Mr. Ford and Mr. Carter were questioned about their positions on government spending for research and development. Mr. Carter thought that both public and private R & D should grow as the economy grows, but that it would be wrong to tie R & D spending to any fixed fraction of any macroeconomic indicator, "for R & D is a microeconomic factor." President Ford argued not that R & D promotes the national economy but that a strong economy is a necessary precondition for science and technology.

These views reflect a consensus of opinion across the otherwise contentious spectrum of our political economy. It would be hard to argue that R & D should drive the national economy. But the absence of any explicit R & D component in macroeconomics flags a significant and puzzling flaw in our national policy machinery.

It is conventional wisdom to say that we see science and technology as only parts of a large family of forces which influence the quality of the national economy. We subordinate their roles to more important elements: skilled management, product diversification, market satisfaction, modernization, entrepreneurship, ingenious infrastructure, and career self-selection. If these elements are not in place and working, R & D is insufficient by itself. On the whole, the thesis stands up. The trouble is that while it has served to explain the past, it may not be good enough to produce a future.

America's macroeconomic goals are not hard to capture and describe. They are to maintain a high standard of living, to confine unemployment within a range of 4 or 5 percent of the work force, to secure a favorable international trade balance, to minimize extreme swings of the business cycle, to produce enough to meet demand without inflation, and to generate enough real growth to create the jobs needed for a growing labor force. These are consensus objectives.

But it is noticeable that when the economic script goes wrong, we invariably grab for the emergency cords of money and credit policy, tax policy, and spending policy. It is doubtful that it ever occurred to an economic czar that an explicit public policy to strengthen public and private technological drive would contribute something of value to long-term stabilization and growth.

There are signs that the vitality of growth-producing technological effort in the United States is not what it used to be. In industry, despite the impressive dollars assigned to R & D, the mix of spending has shifted strongly away from innovation and toward defensive research and development. The U.S. economy cannot count on much of a future if this scenario continues, resting content with old beliefs in the strictly microeconomic role of R & D.

Down at the White House, reorganizers are busy with plans to shape up the sprawling Executive Offices. Someone should be thinking hard about new assumptions as to how the Office of Science and Technology Policy can make a real difference in policy planning. Seen from here, an important difference could be made if the science adviser were linked not only to the President's budgetary staff but also to the Council of Economic Advisers. The time has come to deal with the blind side of science policy.

—WILLIAM D. CAREY

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